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ABSTRACT

Knowledge and skills related to environmental protection are in high demand for any workforce that is both aware of and competent in its actions. Continuous optimization and reform of production structures are essential procedures for ecology-geared corporate processes; therefore, corresponding training for all members of the workforce, from skilled workers to management, is a key factor in making this continuous improvement process possible. In many cases there is a lack of teaching and training materials directly related to business operations. Therefore, teachers and trainers frequently face the problem of how to integrate the issue of environmental protection in the instruction they provide in college or the workplace. As a response to this problem, an interdisciplinary concept for environmental education was developed in the former East Germany to support teachers and trainers in their efforts to integrate sound environmental practices into initial vocational training in a systematic and practical manner. The concept was implemented in the form of manuals on environmental education relating to the following: industrial metalworking occupations, sanitation, heating and air conditioning engineering occupations, construction occupations, motor vehicle occupations, and chemicals occupations. The manuals can be adapted for use by various companies and used for online training. (KC)

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„Environmental Protection – Innovations in Vocational Training and the use of Information Technology for the Purpose of Theme-Oriented Knowledge Management"

I. Introduction – Sustainable Development Strategies

Every occupational activity, be it manufacturing, maintenance or a service, uses materials and objects which contain environmental resources in their natural or a processed form. There are no occupations which have no direct or indirect links with the environment. Occupational activities therefore hold risks to the environment but also potential relief for the pressures weighing on it.

Environmental assets such as clean water, clean air, uncontaminated soil and a stable climate are the bases not only for the very existence and future of all life forms but also for agricultural, industrial and artisanal production. In addition to strengthening the domestic market, environmental expertise and know-how can develop into a sought-after export line.

Economic management which complies with the principle of sustainability can be determined on the basis of three fundamental management criteria against which the sustainability of products, production processes and modes of conduct can be measured:

- ***Regeneration***: renewable natural resources such as timber or fish stocks must only be exploited in the longer term within the limits of their capacity for regeneration lest they be lost to future generations;

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- ***Substitution:*** non renewable natural resources such as minerals or fossil fuels must only be exploited in the longer term to the extent that their functions cannot be substituted by other materials or sources of energy;

- ***Adaptability:*** the release of substances or energy must not be greater in the longer term than the adaptability of ecosystems – e.g. the climate, forests and oceans.

The principle of sustainable development calls for an integrated approach to ecological, cultural, social, economic and global considerations. The prospect of full integration here cannot be guaranteed in the longer term by the instruments of science, technology, economics and law alone. If the principle of sustainable development is to be implemented successfully, there is also a need for education, training and the development of competence in all fields.

II. Environmental Protection and Vocational Training

Seen within this context, knowledge and skills relating to environmental protection – both during training and in working life proper – become quality factors which are in high demand for any workforce which is both aware of and competent in its actions.

Continuous optimization and reform of production structures are essential procedures for ecology-geared corporate processes. Corresponding training provision for all members of the workforce, from skilled worker to management level, is a key factor in making this continuous improvement process possible.

A modern, far-sighted environmental policy therefore attaches particular importance to companies and their workforces implementing sustained environmental protection measures on their own initiative. Implementing a policy of efficient environmental management and corresponding training for all members of the workforce have the direct effect of creating business advantages , e.g. avoiding corporate costs by reducing energy, water and resource consumption, by sorting and recycling waste and by reusing packagings.

Teachers and trainers play a decisive role in developing an understanding and awareness of the environment in initial and continuing vocational training. From personal experience they know how difficult it can be to put across the message that protecting the environment starts with one's routine activities at the workplace. Indeed, effective environmental protection is more than just a matter of

applying technical expertise and complying with regulations and standards.

In many cases there is a lack of teaching and training materials which bear a direct relevance to company operations and motivate students and trainees to behave in an environmentally sound manner. And teachers and trainers frequently face the problem of how to integrate the issue of environmental protection into the instruction they provide at college or the workplace.

In the light of this situation we developed an interdisciplinary concept for environmental education. It supports teachers and trainers in their efforts to integrate sound environmental practices into initial vocational training in a systematic and practical manner. The concept was developed in cooperation with teachers and trainers working in vocational education in the "new" (eastern) federal states of Germany; it was tested there in companies, in vocational training centres and in vocational colleges. It is now available in the form of manuals on environmental education relating to the following: industrial metalworking occupations; sanitation, heating and air conditioning engineering occupations; construction occupations; motor vehicle occupations, and chemicals occupations.

The environmental education concept can be used to support the development of occupation-related environmental skills based on the principles of relevance and practical action. It contains everything which is required for preparing and implementing the training and instruction. The contents, goals and methodologies have been carefully coordinated to facilitate a holistic form of learning.

The concept is structured in three parts, each of these being addressed in turn in the manuals:

- Preparation
- Implementation
- Service

In order to give you a better idea of the contents I will describe a brief example taken from Part 2, which addresses the issue of in-company training procedures.

Occupation-specific module on maintenance

Here the learner is familiarized with how proper maintenance practices can make an important contribution towards a cleaner environment:

- Protecting the environment by means of proper maintenance (e.g. longer use of products and devices)
- Protecting the environment during maintenance operations and by means of alternative maintenance procedures (e.g. mitigation of environmental impact)
- Protecting the environment by means of modernization (e.g. replacement of outdated components).

The basic notions relating to maintenance work are explained in a concise and precise manner. Also provided are specially prepared examples and numerous worksheets which are suitable for photocopying for use by teaching and training personnel in demonstrating the environmental importance of proper maintenance at various steps in the training (e.g. maintenance analysis: the evacuation of air from a hydraulic system).

These measures can, for example, increase the running time of plant and machinery - enhanced use of resources -, recognize frequently occurring faults and environmentally harmful production modes and allow for the corresponding measures - preferably preventive measures - to be initiated.

From the „production process - environmental protection - maintenance" perspective, three areas of action emerge for „environment-oriented training in maintenance procedures":

- environmental protection attained mainly through preventive maintenance procedures,
- environmental protection attained through modernization,
- environmental protection during the maintenance process.

It becomes clear here if not before just how important access to up-to-date information is. Environmental protection can be seen as a particularly pertinent symbol for a sheer plethora of - sometimes contradictory - information and a rapid decline in the half-life of knowledge valid at any particular point in time. More importantly, it demonstrates that certain steps in developing environment-geared training contents do not need to be repeated time and again.

III. Information Technology and Knowledge Management

Working in association with the Federal Ministry of Education and Research, software houses, continuing training providers and research establishments, the Federal Institute for Vocational Training (BIBB) is currently using a framework of various project ideas on the use of global knowledge for innovations in vocational training in order to develop strategies for the structured use of the new information and communication technologies.

The example of environment-oriented vocational training is intended to illustrate the development and testing of didactics and methodologies with a multimedia capability and their implementation in day-to-day initial and continuing training operations. A corresponding lead project – „L3 - Lifelong Learning as a Basic Need" - provides a framework for efforts to address the difficult issue of continuing vocational training in SMEs with the support of multimedia-aided teaching and learning programmes.

The need for continuing training in the environmental field is expanding, the demand for manpower with ecological competence is growing, and the demand for the „unskilled" is declining. The requirement placed on companies and thus on their workforces for flexibility in adjusting to the need for sustainability in their operations will become even more pressing in future. The problem facing SMEs is that they do not run their own training divisions - they have to outsource environmental expertise and training from the market.

Continuing training thus becomes an operation involving space and time constraints and dependence on trainers to which the company has to adapt itself. Continuing training is oriented towards subject coverage and training personnel, it is geared to the average standard of competence required on the market and the average worker. The laws of the market play a more important role here than environmental education as such. The focus is on the rapid (costly) meeting of needs, on calculating the cost of courses rather than on determining actual knowledge requirements; what is received in return is global knowledge rather than answers to one's own specific questions.

Scenario one: The customer wants an environmentally sound product. The supplier needs continuing training to provide that product and books a seminar with an external training provider. The seminar is held three months later. The supplier then submits a quotation for the enquiry and discovers that the

customer has long since bought from a competitor or has in the meantime acquired the expertise himself. This leads to a loss of image and the erosion of customer loyalty.

The conventional seminar format undoubtedly has nothing to contribute today to developing the necessary environmental awareness and thus equally to promoting the necessary environmentally sensitive conduct - as is shown by the scenario already described. The development process can only be speeded up if the expertise and continuing training opportunities are available when they are needed and of course where they are needed.

Lead project L3 is tasked to determine how globally available knowledge can be tapped for the purposes of continuing training. The technological platform for globally available knowledge already exists: the WWW, which is increasingly also being used as a platform for delivering knowledge worldwide.

The WWW is thus becoming the basis for the globalization of knowledge, a universal, globally accessible library. This has its advantages, but it also raises two major problems: firstly the problem of the authenticity of the knowledge made available, a problem which finds expression mainly in the question of the attribution of that knowledge to an author or an authority, and secondly the problem of relating available knowledge to a continuing training need, to a problem at the workplace, this finding expression mainly as a search problem with „lost-in-hyperspace" effects.

The following focuses mainly on the second problem, one which incidentally arises not only in connection with continuing training but also whenever a search operation of any kind is carried out. It is therefore hardly surprising that efforts are currently being made worldwide to find a generally valid solution to this problem. The strategy for solving the problem has already been laid down: web sites or knowledge modules will have to be supplemented with metadata which facilitate narrowly targeted searches and thus make the process of finding knowledge easier and, more particularly, more selective.

Metadata are items of information on the resources themselves and are intended to characterize the knowledge modules in a manner which allows them to be identified more accurately within the relevant context. A national information centre on „environmental education in vocational training" is to test simultaneously the technological developments of the L3 project which are important for the field of environmental information and education from a vocational training perspective.

Metadata for attachment to web sites might comprise straightforward and normal character information or complex descriptions. In the L3 project on lifelong learning we are trying to make use of these possibilities within the context of environmental education. We characterize each individual knowledge module in five ways:

First, each knowledge module is assigned between one and three descriptors which provide information on the subject addressed by the module.

Second, each knowledge module is denoted by its objective relationship to neighbouring modules, e.g. as a part-of relationship, an is-a relationship and so on. This contextual description is needed in connection with the didactic functions.

Third, each knowledge module is characterized by media type; this may be written text, verbal text, photographic image, schematic graphic, slide show, video, freeze-frame video, music, sound, etc.

Fourth, each knowledge module is classified by type of knowledge, by order of level of abstraction as in conventional classification systems, i.e. from explanation (know-why), to performance (know-how), to orientation (know-what) and source (know-where).

And fifth, each knowledge module is characterized within a set of didactic functions. This is the main task to be carried out within the L3 project; the task will entail coining the terms which are most important when knowledge is being sought within a learning context. For example:

Once we have this descriptive language it will be possible to characterize each knowledge module or web site in terms of its function within various methodological and didactic contexts. If a plumber then wants to find out more about utilizing rainwater and moreover wants to do so using the method of learning by guided discovery, a kind of didactic search engine will enable him to find the necessary learning material on the internet. And because everything is described in terms of didactic functions, a hypermedia learning environment will be put together dynamically at the same time - as if for him personally.

Scenario two: The customer wants an environmentally sound product. The supplier makes enquiries at the national information centre for environmental education in vocational training – either immediately

from the workplace or at home that evening via the internet. He obtains information on the subject of the enquiry, on relevant regulations, standards, cost calculation models, profitability accounting and, if he so desires, a course on the subject which will be delivered via the learning method of his choice. He uses the information, submits a quotation and gets the job order.

Once such an information and continuing training opportunity exists, the intrinsic motivation of employers and their worforces will be optimally fired precisely because that opportunity is there when they need it - on demand and just in time - , because the contents can be configured to suit the problems which the company is facing and because the knowledge will be consolidated by being put to practical use (learning by doing).

In addition there are considerable savings in terms of costs to the company. The savings relate to not having to employ the services of training personnel because the learning is self-managed, not having to set aside rooms for training because the training takes place at the workplace, saving on time-loss costs because the learning takes place in specific relation to the problem at hand and on demand, saving on organizational costs because the learning is organized on-line by the individual concerned, and saving on demotivation and transfer costs because the learning is by doing during work. All the continuing training measures are backed up by a hotline manned from 6 a.m. to midnight; the hotline can provide tutorial support on-line, make proposals for company-specific support provision and provide learning aids for self-managed learning which make use of the motivation driven by the problem at hand.

Alongside the on-line tutoring facility, the L3 hypermedia learning environment will provide further possibilities for communication and cooperation. In this respect it will make full use of all available technologies from e-mail to video conferencing and application sharing. More importantly it will allow for cooperation among learning groups located across the world with a view to sharing and continually updating environmental expertise and experience and what the practical application of this expertise and experience entails at the workplace.